Lessons from Social Impacts of Climate Change on Indigenous People from a Dam in Africa

Michele Valery[1]

Abstract

This paper examines the complex interplay between hydropower development, climate change, and socio-economic vulnerabilities in East Africa through a case study of a fourth dam constructed on a contested river system. The analysis highlights how climate change acts as a risk multiplier, exacerbating both the direct impacts of the dam and pre-existing pressures such as land dispossession, interethnic conflict, and resource scarcity. The study reveals that upstream dam construction has disrupted traditional flood-recession agriculture, undermining indigenous livelihoods downstream. Compounding these challenges, a 2021 hydrological study identified a climate paradox: while increased rainfall in southern sub-basins boosts lake inflows (7–11% by mid-century), northern highlands face drying trends, reducing critical dry-season flows. This spatial mismatch creates simultaneous flooding risks and water scarcity, straining hydropower output (projected 18% decline in Dam I) and intensifying competition over dwindling resources. Large-scale agricultural projects further destabilize the basin, with sugarcane plantations diverting 12% of dry-season river flows and polluting water supplies. These pressures intersect with systemic vulnerabilities—state neglect, armed conflict, and failed mitigation efforts—creating a cycle of displacement and violence (e.g., 30 deaths and 10,000 displaced in recent clashes). The paper underscores the urgent need for integrated impact assessments that bridge climatic, infrastructural, and social analyses. It demonstrates how isolated planning approaches exacerbate vulnerabilities, and calls for participatory, climate-adaptive strategies to address interconnected risks in contested river basins.

Introduction

In this paper, we will use a case study concerning the construction of a Hydropower Project (HPP) in East Africa to analyze how the impacts of climate change can intertwine with both the direct impacts of the project and other types of impacts, acting as a multiplier of them. The analysis of this case study, focused on social impacts, will highlight the importance of assessing climate change risks during the early stages of an impact assessment. More specifically, we will analyze the following type of impacts as long as their relationship: (i) the direct consequences of the project itself, (ii) shifting climatic conditions due to climate change, (iii) land grabbing, and (iv) interethnic conflicts.

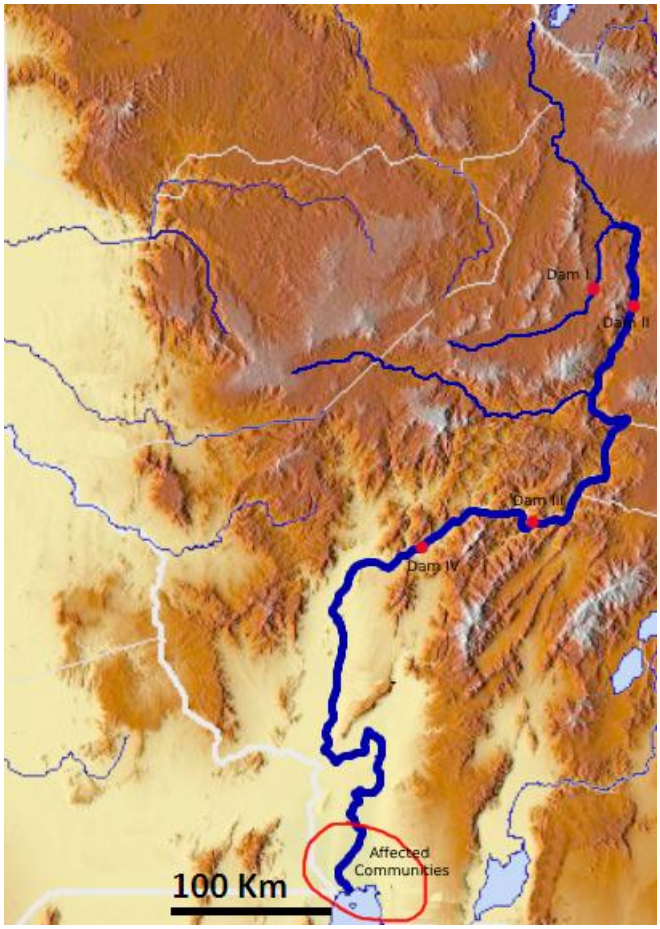
The study has two primary objectives. First, it investigates how climate change may alter the anticipated impacts of the project, potentially intensifying or modifying its effects on local communities. Second, it examines how climate change exacerbates pre-existing pressures, such as land dispossession and ethnic tensions, compounding vulnerabilities. Through the analysis of these interconnected dynamics, this paper will try to contribute to a broader understanding of the complex

[1] Michele Valery has been working in the impact assessment field since 2019. Currently, he holds the role of Social Specialist at RINA Consulting, where he primarily deals with ESIA, ESDD, and related monitoring for financed projects.

interplay between infrastructure development, environmental change, and social vulnerability in contested spaces.

Through this exploration, we aim to provide insights into the need for more holistic impact assessments that account for both climatic and socio-political factors.

Context and direct Project's social impacts



The hydropower project under analysis represents the fourth dam to be constructed on the same river, compounding the cumulative effects of previous developments. A critical issue stems from the start of the operation phase of the third dam (occurred in 2015), which disrupted the river's natural cyclical flooding—a phenomenon that indigenous communities downstream had historically relied upon for flood-recession agriculture. The loss of these seasonal floods has severely undermined traditional livelihoods, leaving local populations struggling to adapt to the altered hydrological regime.

In response to these historical impacts, the Environmental and Social Due Diligence (ESDD) for the fourth dam required the project to develop and implement a Social Development Plan for the downstream area, aimed at supporting affected communities in transitioning to alternative income sources. Additionally, the ESDD emphasized the need for mitigation measures to protect a critical downstream lake, which was projected to face significant depletion due to the compounded effects of upstream dams and changing hydrological conditions.

Socio-Economic Context of Affected Populations

In the downstream area, violent clashes have resurged between two indigenous groups near a lake and river delta, driven by competition over dwindling natural resources (e.g., water, grazing land, and fishing grounds). These tensions are exacerbated by recurring droughts, environmental degradation, and historical colonial borders that divided ethnic groups, creating overlapping territorial claims.

Recent clashes in mid-February left at least 30 dead and displaced 10,000 people, with initial disputes centering on stolen boats and fishing equipment. Retaliatory attacks followed, including militia raids that killed dozens on both sides, with further violence in late February displacing thousands and resulting in significant property losses, including fishing gear and dried fish. Another attack in late March left several dead and wounded, with failed cattle raids triggering further clashes.

Against this backdrop, the affected populations face systemic vulnerabilities, which can be categorized as follows:

1. Historical Marginalization and State Neglect

Both indigenous groups have long been excluded from state-led development initiatives, resulting in inadequate infrastructure, limited access to education, and minimal healthcare services. Government presence in the area is weak, exacerbating feelings of abandonment and fostering self-reliance through informal systems.

2. Resource Dependence and Livelihood Disruption

The communities traditionally relied on cyclical river flooding for flood-recession agriculture—a practice disrupted by upstream dam construction. This has forced them into precarious alternatives like small-scale fishing or pastoralism, intensifying competition over dwindling water and grazing lands.

3. Interethnic Conflict and Armed Violence

Decades of resource competition, fueled by state neglect and easy access to small arms, have entrenched cycles of retaliatory violence. Cattle raiding, once a cultural practice, has evolved into a survival tactic amid economic desperation. The absence of law enforcement perpetuates impunity and insecurity, as seen in recent clashes.

4. Limited Livelihood Alternatives

Formal employment is nearly absent, and dysfunctional education systems leave youth vulnerable to recruitment by armed groups or illicit economies (e.g., smuggling). Women and children disproportionately bear the brunt of displacement and resource scarcity, facing heightened risks of exploitation.

5. Failed Mitigation Efforts

Past interventions, such as livelihood restoration plans, were undermined by poor implementation, lack of community consultation, and failure to address root causes (e.g., land dispossession and climate adaptation needs). Top-down approaches have further alienated locals, reinforcing distrust in external actors.

This fraught context underscores how the hydropower project's impacts are not isolated but intersect with pre-existing vulnerabilities, where each stressor exacerbates the others, leaving communities in a perpetual struggle for survival.

Climate Change and Environmental Stressors in the Lake Basin

The effects of climate change further compound the previously mentioned challenges in the local socio-economic context. At the time of the ESDD, it was estimated that the dams (located on the main tributary of the lake in question) would risk reducing the lake's water flow. However, a 2021 hydrological study of the lake basin revealed a critical paradox in climate change impacts: while total basin inflows are projected to increase, these gains are spatially and temporally uneven, creating simultaneous water surpluses and deficits across the region. This divergence stems from contrasting precipitation trends - increased rainfall in southern and middle sub-basins (10-15% higher monsoon precipitation under RCP 4.5-8.5 scenarios) coupled with decreased rainfall in northern highlands (5-8% reductions in winter/spring months). The study's climate models indicate these changes will lead to a 7-11% increase in flows to the lake from its primary tributary by mid-century, while flows from northern headwaters may decline by up to 18%.

This hydrological divergence has created significant management challenges. The study documents how Dam I, located in the northern highlands, already shows signs of flow regime alteration, with dry season discharges decreasing by an average of 12% between 2015-2021. Projections suggest this could reduce the dam's annual energy output by 18% by 2050. Conversely, southern hydropower infrastructure faces opposite pressures, with increased rainfall raising concerns about sediment loading and flood risk management. The 2021 study calculated that sediment transport in southern tributaries may increase by 20-30% under high emission scenarios, potentially reducing turbine efficiency at downstream dams.

The lake's response to these changes presents further complexities. While the 2021 study projects lake levels may rise over two meters due to increased inflows, this does not translate to uniform benefits. The study's water balance analysis indicates that 25-40% of additional inflows could be offset by increased evaporation rates (projected to rise 5-14% depending on scenario). Moreover, the spatial distribution of impacts creates new vulnerabilities - lakeside communities face heightened flood risks (particularly in low-lying delta regions), while northern pastoralists experience worsening water scarcity as groundwater recharge declines.

Water quality impacts compound these quantity challenges. The study's monitoring data shows that extreme rainfall events already increase pollutant loading to the lake by 30-50% during wet seasons, while drought conditions elevate salinity levels beyond 4,500 μS/cm - approaching thresholds for drinking water and irrigation suitability. These changes interact with existing stressors: the study documents how large-scale agricultural withdrawals in middle sub-basins reduce the system's capacity to buffer climate variability, particularly during dry years.

Cumulative Impacts of Large-Scale Agriculture and Water Stress in the Lake Basin

Indeed, the expansion of large-scale agricultural projects, particularly the biggest sugarcane plantation in the country, has introduced significant pressures on the Lake basin's water resources, compounding the challenges posed by climate variability and competing demands. The abovementioned 2021 study examining the interplay between irrigation developments and

hydrological systems reveals how these projects alter flow regimes, degrade water quality, and exacerbate transboundary tensions—effects that extend far beyond their immediate footprints.

The plantation, one of Africa's largest agricultural schemes, epitomizes these cumulative impacts. Indeed, the plantation diverts substantial volumes from the river, reducing downstream flows into the Lake by an estimated 3.9% annually - a figure that spikes to 12% during dry seasons. While this supports the country's economic ambitions, the study warns that such abstractions disrupt the lake's natural flood cycles, which are critical for replenishing fish habitats and sustaining the already mentioned flood-recession agriculture practiced by indigenous communities in the area.

Water quality degradation further complicates the picture. Intensive sugarcane cultivation relies on fertilizers and pesticides, which leach into the river and eventually the Lake. The study notes that while salinity levels in the lake remain brackish (3,000–4,000 μS/cm), nutrient loading from agricultural runoff could trigger eutrophication, harming fisheries and drinking water supplies. These risks are amplified by the basin's arid conditions, where low flow volumes reduce the river's capacity to dilute pollutants.

The cumulative effects extend to groundwater systems as well. The study highlights concerns over falling water tables in the region, where aquifer recharge is already limited. Large-scale irrigation reduces seepage into alluvial deposits downstream, potentially exacerbating water scarcity for pastoralists who rely on wells during droughts. This hydrological interference intersects with climate change in dangerous ways: projections of increased evaporation and erratic rainfall could make groundwater depletion irreversible in some areas.

Ultimately, the Lake basin's future hinges on balancing economic development with ecological resilience. The 2021 study underscores that large-scale agriculture, while economically transformative, cannot be pursued in isolation from its cumulative hydrological and social costs. Without integrated planning, the basin risks cascading failures—from collapsed fisheries to inter-ethnic conflicts—that could undo decades of progress. The challenge for policymakers is to reconcile national ambitions with the imperative of sustaining a shared lifeline for millions.

Conclusions

The case study of this hydropower project in Africa underscores a critical reality: different types of impacts—environmental, social, and climatic—do not operate in isolation but rather interact in complex and often reinforcing ways. Climate change, in particular, acts as a risk multiplier, exacerbating both the direct consequences of infrastructure development and pre-existing socio-economic vulnerabilities.

The analysis reveals how shifting precipitation patterns, rising temperatures, and altered hydrological regimes interact with dam operations, large-scale agriculture, and interethnic conflict, creating a cascade of pressures on already marginalized communities. Notably, while climate models predict increased inflows to the lake in some scenarios, this does not uniformly translate into stability; instead, it introduces new risks, such as flooding and water quality degradation, while other areas face intensified droughts. These dynamics demonstrate that climate change does not merely add to existing challenges—it reshapes them, demanding adaptive and context-specific mitigation strategies.

A key lesson from this case is that conventional impact assessments, which often treat climatic, social, and infrastructural impacts as separate domains, are insufficient. The compounding effects seen here—where dam-induced hydrological changes intersect with climate variability, resource competition, and violent conflict—highlight the necessity of integrated risk assessments that account for these interconnections. Most critically, climate change risks must be evaluated early and rigorously, as the local climatic context directly influences the effectiveness of social mitigation measures. For instance, livelihood restoration programs designed without considering future rainfall variability or extreme weather events may fail, further entrenching vulnerability rather than alleviating it.

Ultimately, this case calls for a paradigm shift in impact assessment frameworks—one that moves beyond isolated analyses and embraces a systemic understanding of risks. Only by recognizing how different stressors interact can planners develop resilient and adaptive solutions that address not just the symptoms of conflict and displacement but their root causes in a rapidly changing climate.

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